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U1S S1891 S1893

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EP 0356741 A1 **US 4940976 A**

(58) Field of Search
UK CL (Edition P) **G1N NAHJA , H4L LCC LCT LCX**
INT CL^6 **G01D 4/00 4/08 , G01F 15/06 , G08C 17/00**
17/04 17/06 , H01F 38/14 , H04B 5/00
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(54) Abstract Title
Remote reading of utility meters

(57) An apparatus for remotely reading a utility meter, such as a gas or water meter, comprises an automatic meter reading means 7 for sensing the rotation of the meter dials and for producing an output signal indicative of the meter reading. The output of the meter reading means 7 is transmitted via an antenna 10 which comprises a wire 14-16 wrapped around the utility supply pipe. The supply pipe is then used to transmit the data to the exterior of the premises where it is received by a correspondingly designed antenna. Readings from a plurality of premises may each have their own identification codes and may be collected locally via the supply network and subsequently transmitted to a central collection point via conventional data transmission means, eg optical fibres, telephony etc.

The wire comprises a conducting core 14, surrounded by an insulative sleeve which includes male and female connecting portions 16,17 formed therein so that when the wire is wound around the pipe, each successive turn interlocks with the previous one.

Rotation of the meter dials is sensed by use of a magnet and Hall effect arrangement.

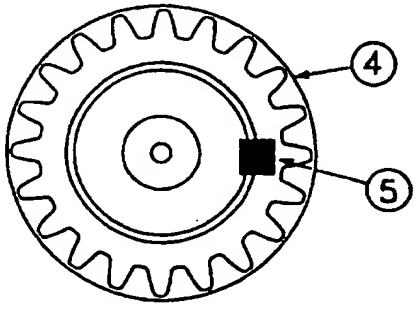

FIG. 2

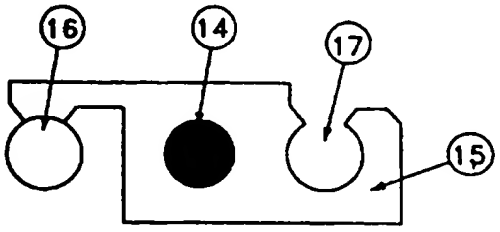

FIG. 5

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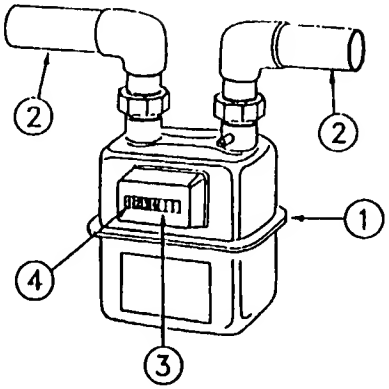


FIG. 1

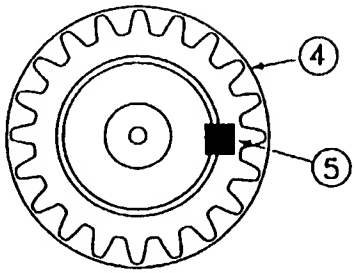


FIG. 2

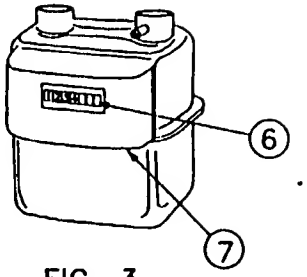
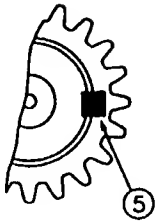


FIG. 3



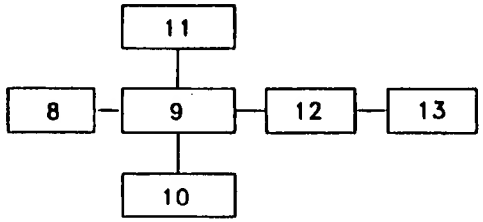


FIG. 4

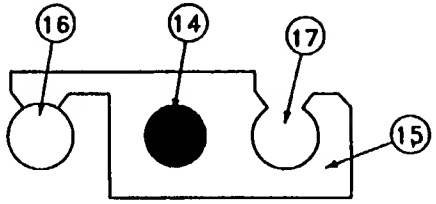


FIG. 5

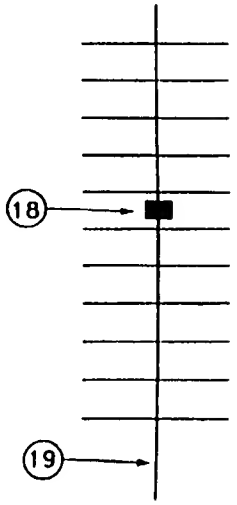


FIG. 6

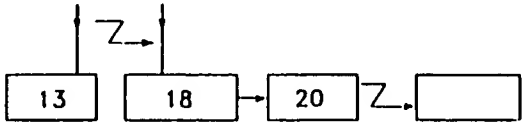


FIG. 7

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METHOD AND APPARATUS FOR REMOTE READING OF UTILITY METERS

This invention relates to a method and apparatus for the remote reading of utility meters, eg gas, water and electricity meters.

Conventionally the usage of a utility such as gas, water or electricity, is paid for in proportion to that usage which is measured by a meter. Generally the meter is located within the premises concerned and at periodic intervals the meter is read by a person from the utility company visiting the premises.

Such a conventional arrangement has numerous disadvantages. For example it is very labour intensive, requiring regular visits to customers, and also it is very inconvenient since it requires the customer to be at home to allow the meter to be read. Commonly when all adult members of a household are working there may be nobody at home and the meter cannot be read. In such cases the utility bill must be estimated or read by the consumer him/herself and the reading then given to the utility company. This problem may recur repeatedly and it is not uncommon for a domestic utility meter to go unread for many months.

The problem of accessibility to the meter can be overcome by locating the meter outside of the premises. But doing so is not always possible, and even when it is there is a risk of the meter being tampered with or vandalised, and the process of meter reading is still very labour intensive.

To overcome these problems various schemes for the remote reading of utility meters have been proposed. Many such proposals involve the transmission of data concerning utility usage from the meter to a receiving unit outside of the premises. This normally involves the free-space propagation of an electromagnetic wave from the inside of premises to the outside and as such is subject to potential interference and signal attenuation as the data is transmitted through the walls of a building. A utility meter is often located inside a cabinet or cupboard the walls and door of which cause a particular problem. Furniture, and even metal window frames can all result in either interference or signal attenuation. Such interference and attenuation can seriously degrade the signal unless it is sufficiently strong, and this means that a signal receiving unit must be

The transmitting means preferably comprises an antenna wound around the utility supply conduit. In particular the antenna comprises a cable of conductive wire coated in an insulating material and wrapped around the utility supply conduit in a spiral manner. Preferably the cable is formed with an engagement and locking means such that as the cable is wound around the conduit each turn engages and locks with an adjacent turn. To this end the cable is formed with an elongate male locking member parallel and to one side of the wire, and a corresponding female receiving portion parallel to and on the other side of the wire. With such a construction as the cable is wound around the supply conduit the male locking member of one turn engages in the corresponding female receiving portion of the adjacent turn. This arrangement provides a secure method of fixing the antenna to the supply conduit.

The receiving means may be an antenna of the same structure as the transmitting means.

The utility supply conduits of a number of premises are of course all linked together to a supply. For example, in a street of houses each house will have gas and water pipes branching off of a mains supply. In a large apartment block a number of risers will be provided, each riser supplying a number of apartments on each floor. Preferably the apparatus of the present invention provides means for receiving data from a plurality of premises. In such an embodiment the transmitting means adds to the meter reading transmitted a code identifying the premises concerned. The data may also only be transmitted from a premises at a given time during the day, with various premises transmitting data at different times. This provides further identification, but more importantly allows the data from a number of premises to be spread over a period of time to minimise congestion and avoid interference between signals.The data from a plurality of such receiving means may then be transmitted to a base station and then in turn to a head office.

Viewed from another aspect the present invention provides a method for the remote reading of a utility meter comprising, generating a signal indicative of the meter reading, transmitting said signal along a utility supply conduit from a point interior of a premises to a point exterior of said premises, and receiving said signal.

Preferably the signals from a plurality of premises are transmitted along a utility supply network to a data receiving means, with each said signal being provided with an identifying code corresponding to the premises concerned.

Viewed from a further broad aspect the present invention comprises apparatus for generating an electrical signal indicative of a reading of a utility meter comprising at least one rotating dial, said apparatus comprising a magnet associated with said dial so as to rotate therewith, and magnet sensing means adjacent said dial, said magnet sensing means comprising an integrated circuit including a Hall effect element producing an output varying cyclically in response to rotation of the magnet.

Viewed from a further broad aspect the present invention provides an antenna for transmitting a signal along a conductive element comprising, a cable adapted to be wound around said conductive element in a spiral manner, said cable comprising conductive wire coated in an insulating material and being formed with an elongate male locking member parallel to and to one side of the wire, and a corresponding female receiving portion parallel to and on the other side of the wire, whereby as the cable is wound around the conductive element the male locking member of one turn engages in the corresponding female receiving portion of the previous turn.

Viewed from a still further broad aspect of the present invention provides apparatus for the remote reading of utility meters in a plurality of premises comprising, means located in each said premises for transmitting data indicative of the meter reading, means for collecting the data transmitted from a plurality of premises, and means for transmitting said collected data to a central collection point.

An embodiment of the present invention will now be described by way of example and with reference to the accompanying drawings, in which:

Fig.1 is a perspective view of a standard utility meter,

Fig.2 is a side view of a meter dial,

Fig.3 is a perspective view of an electronic meter reading unit attached to a meter,

Fig.4 illustrates schematically the operation of the meter reading unit,

Fig.5 is a view in cross-section illustrating a data transmission antenna,

Fig.6 illustrates the use of a single collection point for data from a plurality of premises, and

Fig.7 illustrates schematically the data transmission sequence.

Referring firstly to Fig.1 there is shown a conventional form of utility meter, for example a gas or water meter. The meter comprises a meter body 1 into which enters and leaves a utility supply conduit 2. The meter body 1 has a window 3 through which may be seen a number of meter dials 4. The meter dials 4 bear digits and in the meter flow of the utility through the meter is used to generate a mechanical action that can be used to cause rotary motion of the dials. Thus the position of the dials in indicative of the amount of utility flowing through the meter and conventionally a meter is read by a person inspecting the positions of the dials and noting the numbers.

Conventionally a meter may have eight dials: one for 10,000s, one for 1000s, one for 100s, one for 10s, one for single digits and three for three decimal places. This allows a meter reading of the form 12345.678. Fewer or more dials would also be possible, however. In the system of the present invention a magnet 5 is fixed to one of the dials as shown in Fig.2. As will be explained below, this magnet is used to automatically read the meter by sensing the number of rotations of the dial. While the magnet may be fixed to any of the dials, the dial the magnet is fixed to is chosen by matching a sampling frequency of the sensing means 8 with the turning speed of the dials (and hence the flow rate of the utility supplied). Placing the magnet on the fastest rotating dial, ie the third decimal place, would require a higher sampling rate, and the sampling rate is limited by power consumption (especially if the meter reading means is battery powered). Good results can be obtained if the magnet is fixed to the first decimal place, though other dials may be chosen depending on the form of the meter.

An automatic meter reading means 7 is provided that may be fixed directly to the front of the meter body 1. The meter reading means 7 is provided with a window 6 that allows the dials 4 to be read in the normal manner, either by the occupier of the premises so that they can keep a check on usage, and also by the utility company should a conventional manual reading of the meter be necessary.

As is shown in Fig.4 the meter reading means 7 includes a Hall IC sensing means 8. A Hall IC is an integrated circuit that includes a Hall effect element the output of which is responsive to an applied magnetic field. Depending on its sensitivity, the Hall IC sensing means may need to be located within the meter itself. As the dial 4 bearing the

magnet 5 rotates the position of the magnet 5 relative to the Hall IC 8 varies cyclically and thus so does the output of the Hall IC 8. One cycle of the Hall IC 8 output corresponding to one rotation of the dial 4.

The output from the Hall IC 8 is taken to an accumulating means 9 which counts and sums the Hall IC output cycle and thus the number of rotations of the meter dial 4. At intervals the sum total calculated by the accumulating means is in turn output as a meter reading. This output may be taken at predetermined intervals (eg every day, every week, every month, or every quarter) in response to a clock signal from clock means 10, or the output may be taken at any desired time upon request from an output demand means 11. Regular, say monthly, readings may be normal for routine meter readings to generate a bill, but special one off readings may be required at times, for example upon change of occupancy of the premises.

The output from the accumulating means 9 is first amplified by amplifier 12 and then passed to an antenna 13 for transmission. The structure of the antenna 13 is shown in Fig.5. The antenna is a quarter-wavelength antenna comprising a cable that is wound around the utility supply conduit, ie a water or gas pipe, with the total length of the antenna wire being equal to one quarter wavelength. The cable comprises a conductive wire 14 protected by an insulating sheath 15 of insulating material. The insulating material is formed with engagement and locking means in the form of a male engaging member 16 to one side of and parallel to the conductive wire 14, and a correspondingly shaped female receiving portion 17 formed on the other side of and also parallel to the conductive wire. Thus when the cable is wound spirally around the gas or water pipe, the male locking member 16 of one turn will engage with the female receiving portion 17 of an adjacent turn. In this way the cable may be securely wound around the pipe and will be held in place without any difficulty.

In use, the antenna 13 generates an electromagnetic field in response to the output from the accumulating means and this field is propagated along the gas or water pipe. As a general rule a higher transmission frequency would result in the best data transmission, but at the expense of increased component costs. The transmission frequency may also need to be in a band authorised for use by an appropriate regulatory authority. A typical

suitable transmission frequency would be 40.68MHz ± 5kHz in a Frequency Shift Keying format.

By definition the gas or water pipe will extend to the exterior of the premises and thus a receiving antenna can be located outside of the premises. The receiving antenna may be of a corresponding structure to the transmitting antenna. In this way the utility supply pipes may be used to transmit data corresponding to a meter reading to a remote point. The problems of free-space transmission are avoided, but at the same time by using the existing and essential supply pipes for the data transmission, the need to install special data transmission means is avoided. The utility supply conduits are highly suitable for this purpose since they are normally made of iron or copper, which are of course good conducting materials.

In a normal arrangement the utility supply conduits of a number of premises are of course all linked to a common supply. For example, in a street of houses each house will have gas and water pipes branching off of a mains supply. In a large apartment block a number of risers will be provided, each riser supplying a number of apartments on each floor. Conceivably the data concerning a meter reading for an individual premises may be read on an individual basis by locating the receiving antenna before the supply pipe for that premises rejoins a larger network. However, it is far more efficient to take advantage of the existing network of gas or water pipes and for the data from a number of premises to be collected at a single point before onward transmission to the head office or accounting office of the utility company.

For example, in an apartment block of, say, 30 storeys with eight apartments per storey, conventionally four risers will be provided each serving two apartments per storey. Data receiving means 18 including a receiving antenna may be provided every ten storeys and connected to each of the four risers 19 receiving data from five storeys above and five storeys below, a total of 80 apartments. This is illustrated in Fig.6. The problem of interference and potential beating between signals from different meters can be mitigated by time-spreading the transmissions from various apartments as discussed above. For such a building three data receiving means may serve for the whole building, and in turn these data receiving means may transmit the data they receive to a base station 20 which collects together all the data for the whole building (or indeed several

buildings) for onward transmission to the head office or accounting office of the utility company.

This scheme is illustrated in Fig.7. In such an arrangement, before the meter reading data is output the meter reading means 7 adds to the meter reading data a code identifying the premises concerned in order that the meter reading can be allocated to the appropriate utility company account. The base station may also carry out data management functions. For example the base station may be provided with a database of the premises covered by the data receiving means that feed the base station, including for example names, account numbers and so on, and this information may be matched with the meter reading data before onward transmission so as to decentralise as much of the billing process as necessary.

The number of apartments that a single data receiving means can handle will be limited only by the degree of attenuation of the data as it is transmitted along the gas or water pipes. Once gathered by the data receiving means, the data is then transmitted to the base station and on to the head office or accounting office by conventional data transmission means, eg optical fibres, telephone lines and so on.

CLAIMS

1. Apparatus for the remote reading of a utility meter comprising, means for generating a signal indicative of a meter reading, means for transmitting said signal along a utility supply conduit extending from a point within premises to the exterior of said premises, and means located outside of said premises for receiving said signal transmitted along said utility supply conduit.

2. Apparatus as claimed in claim 1 wherein said signal generating means comprises a magnet fixed to a dial of the said utility meter, and means provided adjacent the dial for sensing movement of the magnet.

3. Apparatus as claimed in claim 2 wherein said signal generating means produces an output pulse upon each rotation of said dial, and said output pulses are accumulated in accumulating means to provide a running total.

4. Apparatus as claimed in claim 3 wherein the running total stored in said accumulating means is output at predetermined intervals to said signal transmitting means.

5. Apparatus as claimed in claim 3 wherein the running total stored in said accumulating means may be output on demand to said signal transmitting means.

6. Apparatus as claimed in any of claims 2 to 5 wherein said magnet movement sensing means comprises a Hall effect element.

7. Apparatus as claimed in any preceding claim wherein said signal transmitting means comprises an antenna wound around the utility supply conduit.

8. Apparatus as claimed in claim 7 wherein the antenna comprises a cable of conductive wire coated in an insulating material and wrapped around the utility supply

conduit in a spiral manner, and wherein the cable is formed with an engagement and locking means such that as the cable is wound around the conduit each turn engages and locks with an adjacent turn.

9. Apparatus as claimed in claim 8 wherein the cable is formed with an elongate male locking member parallel to and to one side of the wire, and a corresponding female receiving portion parallel to and to the other side of the wire.

10. Apparatus as claimed in any preceding claim wherein means are provided for receiving data from a number of premises, and wherein apparatus includes means for adding a code to said data identifying the premises concerned.

11. A method for the remote reading of a utility meter comprising, generating a signal indicative of the meter reading, transmitting said signal along a utility supply conduit from a point interior of a premises to a point exterior of said premises, and receiving said signal.

12. A method as claimed in claim 11 wherein the signals from a plurality of premises are transmitted along a utility supply network to a data receiving means, each said signal being provided with an identifying code corresponding to the premises concerned.

13. Apparatus for generating an electrical signal indicative of a reading of a utility meter comprising at least one rotating dial, said apparatus comprising a magnet associated with said dial so as to rotate therewith, and magnet sensing means adjacent said dial, said magnet sensing means comprising an integrated circuit including a Hall effect element producing an output varying cyclically in response to rotation of the magnet.

14. An antenna for transmitting a signal along a conductive element comprising, a cable adapted to be wound around said conductive element in a spiral manner, said cable comprising conductive wire coated in an insulating material and being formed with an

elongate male looking member parallel to and to one side of the wire, and a corresponding female receiving portion parallel to and to the other side of the wire, whereby as the cable is wound around the conductive element the male locking member of one turn engages in the corresponding female receiving portion of an adjacent turn.

15. Apparatus for the remote reading of utility meters in a plurality of premises comprising, means located in each said premises for transmitting data indicative of the meter reading, means for collecting the data received from a plurality of premises, and means for transmitting said collected data to a central collection point.

The Patent Office

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Application No: GB 9807598.9
Claims searched: 1 to 12

Examiner: Jared Stokes
Date of search: 19 October 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): G1N (AHJA)
H4L (LCT, LCC, LCX)

Int Cl (Ed.6): G01D (4/00, 4/08)
G01F (15/06)
G08C (17/00, 17/04, 17/06)
H01F (38/14)
H04B (5/00)

Other: On-Line - WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2 279 536 A	(Coal) See abstract	7
Y	GB 2 223 593 A	(Yazaki) See whole document	2-6
X,Y	EP 0 661 526 A1	(Maycom) See whole document	X: 1,10, 11,12 Y: 7
X,Y	EP 0 356 741 A1	(Misuratori) See whole document	X: 1,7,10, 11,12 Y:2-6
A	US 4 940 976	(Utilicom) See abtract	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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